UNIVERSITY of DAYTON
VISION LAB
Center of Excellence for Computer Vision and Wide Area Surveillance Research

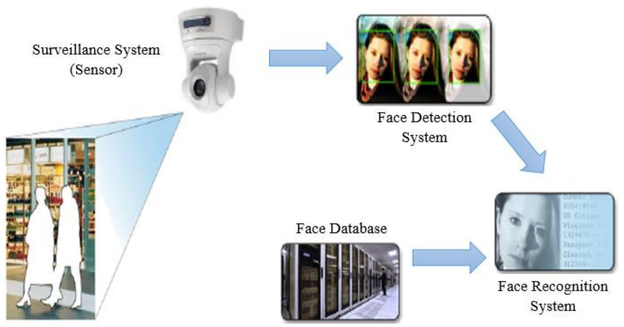
Almabrok Essa
Advisor: Dr. Vijayan Asari

Local Difference Sign-Magnitude Transform (LDSMT) of Edge/Corner Features for Robust Face Recognition

Overview

Face detection and recognition system generally involves two separate stages:

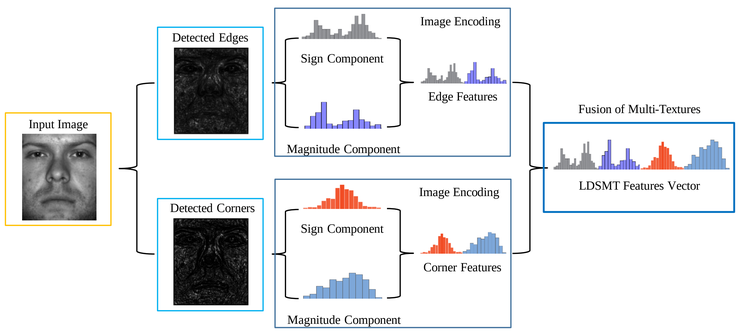
- Face Detection: where an image is searched to find any face.
- Face Recognition: where that detected face is compared to a database of known faces, to decide who that person is.



Proposed Scheme

The proposed LDSMT method can be summarized into three main stages:

- Edge & corner extraction.
- Image encoding & decoding.
- Fusion of multiple texture sets.



Edge & Corner Extraction

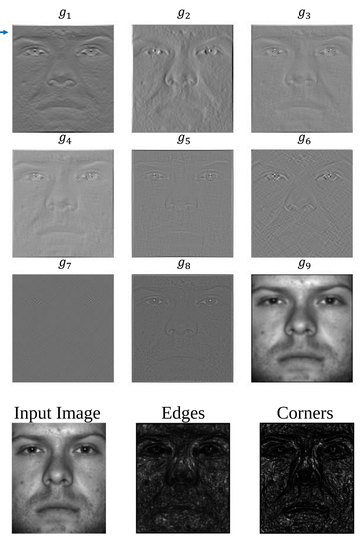
To extract the edges and corners information, we utilize the properties of Frei-Chen edge detector. Given an input image $I(x, y)$, the nine different edge, corner, and mean responses g_i can be computed by:

$$g_i = I(x,y) * K_i \quad for\ i = 1,2,\dots,9$$

$$K_1 = \begin{bmatrix} 1 & \sqrt{2} & 1 \\ 0 & 0 & 0 \\ -1 & -\sqrt{2} & -1 \end{bmatrix} \quad K_2 = \begin{bmatrix} 1 & 0 & -1 \\ \sqrt{2} & 0 & -\sqrt{2} \\ 1 & 0 & -1 \end{bmatrix} \quad K_3 = \begin{bmatrix} 0 & -1 & \sqrt{2} \\ 1 & 0 & -1 \\ -\sqrt{2} & 1 & 0 \end{bmatrix}$$

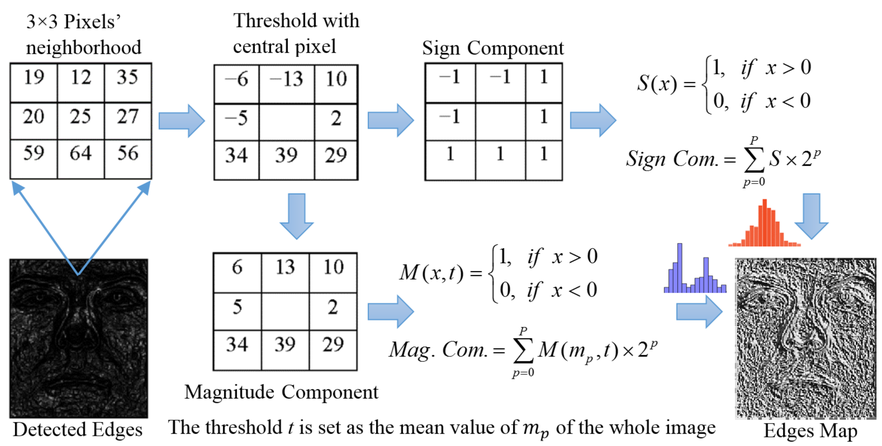
$$K_4 = \begin{bmatrix} \sqrt{2} & -1 & 0 \\ -1 & 0 & 1 \\ 0 & 1 & -\sqrt{2} \end{bmatrix} \quad K_5 = \begin{bmatrix} 0 & 1 & 0 \\ -1 & 0 & -1 \\ 0 & 1 & 0 \end{bmatrix} \quad K_6 = \begin{bmatrix} -1 & 0 & 1 \\ 0 & 0 & 0 \\ 1 & 0 & -1 \end{bmatrix}$$

$$K_7 = \begin{bmatrix} 1 & -2 & 1 \\ -2 & 4 & -2 \\ 1 & -2 & 1 \end{bmatrix} \quad K_8 = \begin{bmatrix} -2 & 1 & -2 \\ 1 & 4 & 1 \\ -2 & 1 & -2 \end{bmatrix} \quad K_9 = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$$



$$Edge = \sqrt{\frac{\sum_{i=1}^{4} g_i^2}{\sum_{i=1}^{9} g_i^2}} \quad and \quad Corner = \sqrt{\frac{\sum_{i=5}^{8} g_i^2}{\sum_{i=1}^{9} g_i^2}}$$

Image Encoding & Decoding



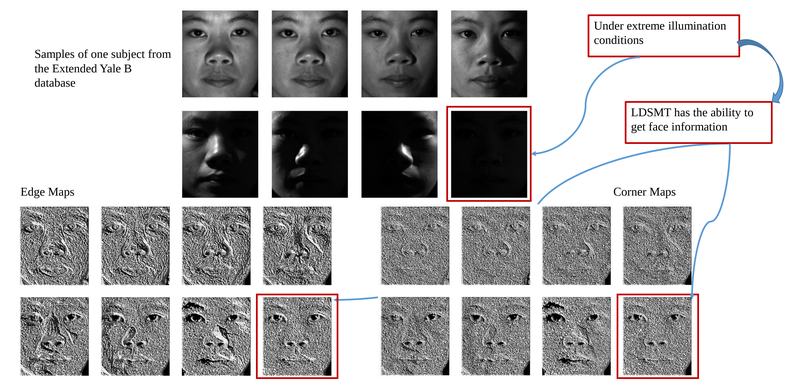
The threshold t is set as the mean value of m_p of the whole image

Experimental Results

Database Description

For evaluation two datasets have been used:

- Extended Yale B database.
  - 2280 face images for 38 subjects each person 60 images.
- AT&T database.
  - 400 face images for 40 subjects representing 10/subject.



Recognition Accuracy

To avoid any bias, half of the data randomly selected for training and the other for testing. The experiments were repeated 10 times, then the average results are calculated.

Database	Method			
	LBP	LDP	LTP	LDSMT
Extended Yale B	96.07 %	97.76 %	98.25 %	**99.19 %**
AT&T	87.80 %	88.50 %	91.80 %	**98.32 %**

LBP: Local Binary Pattern, LDP: Local Directional Pattern, and LTP: Local Ternary Pattern.

UNIVERSITY of DAYTON
Vision Lab
Kettering Laboratories
300 College Park
Dayton, OH 45469-0232

UD VISION LAB
www.visionlab.udayton.edu

Dr. Vijayan Asari
Director
(937) 229-4504
VAsari1@udayton.edu